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Research on the electrical parameters of modern LED street luminaire

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Abstract

The report presents the study of the electrical parameters (P, Q, S, cos φ, harmonic pollution, etc.) of a modern LED street luminaire.

For the purpose of the study, an LED streetlight luminaire with COB-LED and a glass optical system was selected. The electrical power of the luminaire is 30 watts, the power supply voltage is 220 volts, the driver is on reputable manufacturer.

The luminaire has been studied for a long period of operation for a period of 1 month. To measure the data, a power network analyzer with very good accuracy and the ability to record the measured parameters is used. The report presents the results of the measurement of the LED illuminator and the processing of the received data.

There are made appropriate conclusions from the study.

Index Terms: LED street light, LED parameters, electrical parameters of LED

1 Introduction/Einleitung

The use of LED street luminaires is becoming more and more common in the design and reconstruction of street lighting systems. Taking into account the advantages of LED luminaires (such as longer life, better efficiency, better light quality), we should also not overlook the problems that might arise on the parameters on power grid. This is mainly due to the fact, that these luminaires are electronic devices, that need a stable DC power supply. Typically, the power modules are pulse power supplies with different characteristics and qualities.

The purpose of the work is to study the electrical parameters (P, Q, S, cos φ, PF, harmonic pollution and etc.) of a modern street lighting.

2 Exposition

For the purposes of the present study, a modern street LED luminaire was selected, with electrical power 30W and the 220 VAC supply voltage. The illuminator is shown in Fig. 1. Fig. 2 shows the light distribution curve and the cone diagram of the luminaire.

Figure 1. LED street luminaire Vega 1-30

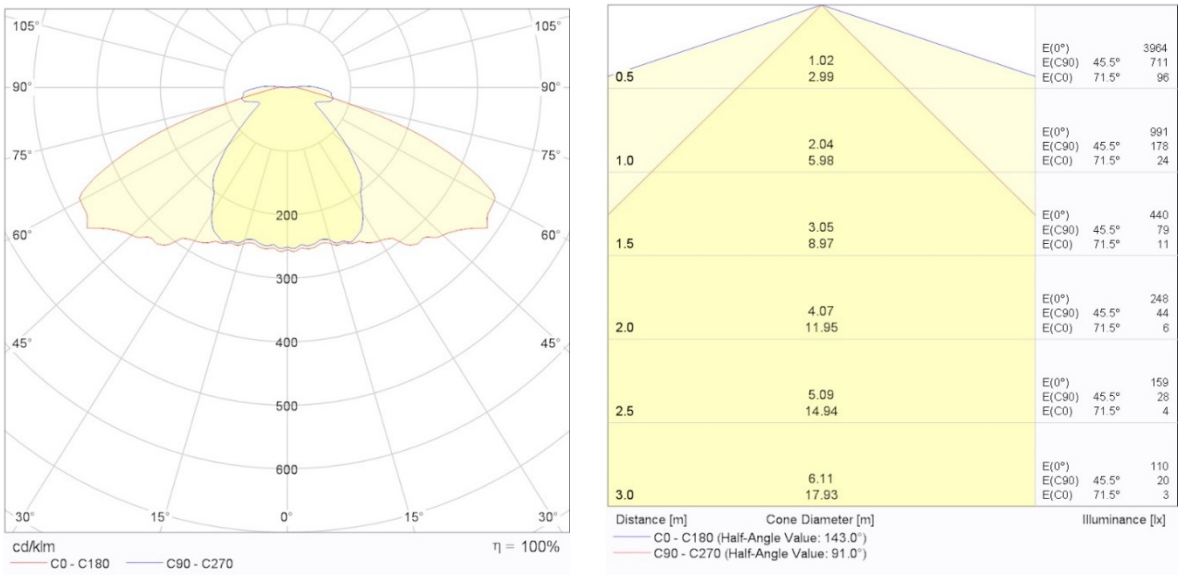

Figure 2. Light distribution curve and the cone diagram of the luminaire Vega 1-30

In the table 1 are shown the characteristics of street LED luminaire.

Table 1.

Technical characteristics of the tested luminaire

Model	Vega 1-30
LED Chip	CITIZEN
LED Driver	Meanwell
Power Factor	> 0.95
Input Voltage	190 – 250 V
Electrical Power	30 W
Luminous Flux	3900 Lm
Type of light	DayLight
Color temperature	5000 K
Index on Color Rendering	> 80 Ra
Working range	–35 °C to +45 °C
Protection	IP 66
Operating Life	*over 50 000 h*
Body	Aluminum

The network analyzer - BMR Power Line Analyzer PLA33DL with very good technical parameters and good measurement accuracy (± 1% error) was used to study the electrical parameters of the power supply network. The measurement is carried out for one month during the summer period, with the interval of recording the parameters being 5 min. The summer period is selected since the illuminator is operating in a heavier temperature mode. The measurements meet the requirements of EN 61010-1, EN 61000.

After processing the obtained results, was calculated the averaged values of the electrical parameters, and there are presented in Table 2. On Fig. 3.1 - 3.3 there are shown the graphical dependencies of some of the studied parameters.

Table 2.

Measurement of the electrical parameters of the tested luminaire

Voltage parameters

Harmonic, Y	Yu, V	Yu, %
1	224,5	100
3	1	0,5
5	3,7	1,6
7	0,6	0,3
9	1,3	0,6
11	0,5	0,2
13	0,9	0,4
15	0,7	0,3
17	0,4	0,2
19	0,4	0,2

P =	0,031	kW
S =	0,032	kVA
cos φ =	0,957	
PF =	0,931	
Q =	-0,007	kVAr

THD U =	1,9	%
RMS =	224,6	V

Current parameters

Harmonic, Y	Y_I, A	Y_I, %
1	0,15	100
3	0,08	55,2
5	0,03	17,2
7	0,01	3,4
9	0	0
11	0	0
13	0	0
15	0	0
17	0,01	3,4
19	0	0

THD I =	55,1	%
RMS =	0,15	A

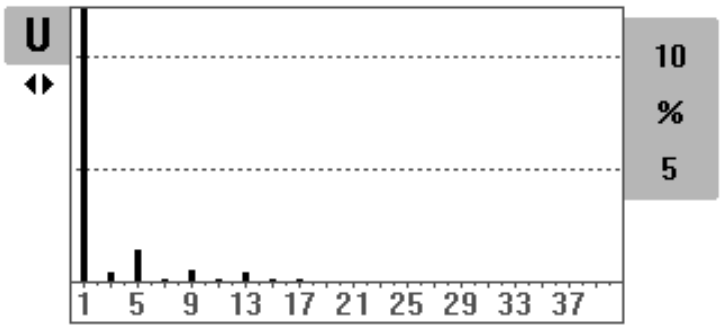

Figure 3.1. Generated Harmonic Voltage Pollution

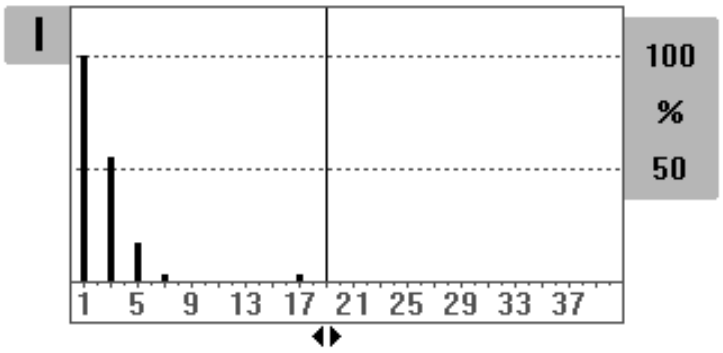

Figure 3.2. Generated Harmonic Cuurent Pollution

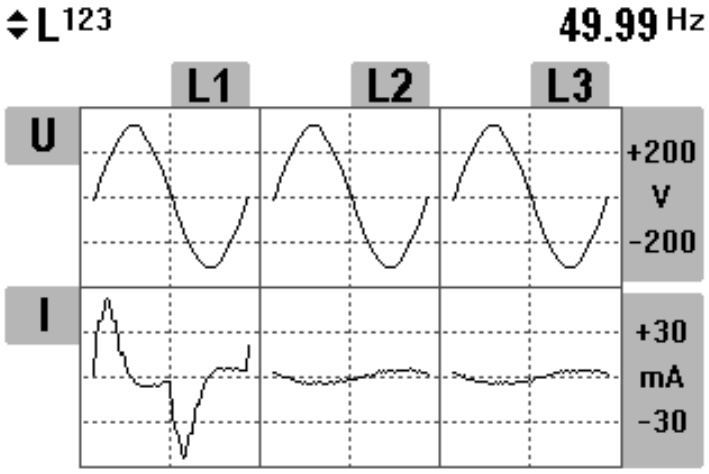

Figure 3.3. Form of the sinewave of the supply voltage and current

After analyzing the presented data, we can observe the following:

- The basic electrical parameters, determining the quality of the electrical energy, for the studied luminaire are very good. The cos φ parameter has a high value close to that declared by the manufacturer. The PF parameter also has a high value. These two parameters indicate that we will have minimal losses of reactive energy;
- The THD U parameter, defining the generated harmonic voltage pollutions, has a very small value. This is also evident from the graphical interpretation of voltage harmonics;
- The THD I parameter defining the generated total harmonic current pollutions has a very high value exceeding the recommended one according to EN 61000. From the graphical dependence, it is apparent that these are mainly harmonics 3 and 5;
- The current sine wave is highly distorted, due to the high THD I parameter.

3 Conclusion

1. The electrical parameters of a street-type LED luminaire of a modern type were studied. Tested luminaire have a nominal electrical power of 30 W and a quality power module.
2. It has been established from the tests, that the THD I parameter, which determines the generated total harmonic current pollutions, has a very high value (THD I = 55.1%) exceeding the recommended according to EN 61000. From the graphical dependence are shown that this is harmonics with numbers 3 and 5. When constructing a lighting system comprising many luminaires, respectively increasing the power of the system, it can be expected that the influence of harmonics on current will be substantial.
3. The remaining electrical parameters are within the limits prescribed by the standard.

4 References

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